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NUMBER FOUR
CYCLES OF UNEMPLOYMENT
IN THE UNITED STATES
1903-1922

CYCLES
OF UNEMPLOYMENT
In the United States
1903-1922

BY
WILLIAM A. BERRIDGE, PH.D.
Assistant Professor of Economics, Brown University



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TO
MY FATHER AND MOTHER

PREFATORY NOTE

FROM the two hundred essays submitted to the Pollak Foundation in 1921, the judges — Wallace B. Donham, Irving Fisher, and Wesley C. Mitchell — unanimously selected for the first prize of one thousand dollars a study of Unemployment and Business Cycles, by William A. Berridge, then an Instructor and graduate student in Harvard University. That study, revised and brought up to date, is here presented as Number Four of the Pollak Publications. It supplements the studies on Index Numbers, Money, Costs and Profits, and Bank Credit which are listed in the back of this book.

After the close of the Prize Contest, contributions on this subject by Dr. Berridge were published, with the approval of the Pollak Foundation, in the *Harvard Review of Economic Statistics*, in the *Journal of the American*

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Statistical Association, and in the publications of the Conference on Unemployment appointed by President Harding. In this separate volume, Dr. Berridge's studies are made readily available for wider use than heretofore, and are especially adapted to the needs of the business man, the social worker, and the public-spirited citizen. The inevitable technical difficulties connected with the scientific treatment of this subject have been dealt with so successfully that they need not stand in the way of any intelligent reader. Those who wish to go further into the statistical aspects of the subject will find additional discussion and references in the Appendix.

When the President's Conference on Unemployment met during the recent period of business depression, the first difficulty encountered was the meagerness of the available data concerning the exact nature and extent of the evils with which the Conference was concerned. A Committee, chosen from

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among the best-qualified economists in the country, was asked to furnish the Conference with comprehensive statistics concerning the volume and distribution of existing unemployment, comparative conditions in previous years, and the relation of cycles of unemployment to cycles of production, of prices, of volume of trade, and of other economic variables that make up the complicated composite that goes under the general name of "the business cycle." This Committee was obliged to conclude that all estimates were to such a large extent guesswork as to be of little value. Some agencies were reporting the number of unemployed as above six million: others were insisting that the total number of unemployed was under three million. Evidently, no basis was yet at hand for a scientific solution of one of the most persistent, most crucial, and most widely discussed of public problems. The Committee urged upon the Conference the primary need of more reli-

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able quantitative studies. The Pollak Foundation believes that the following statistical study is a step toward satisfying that need: it is a contribution to our exact knowledge concerning fluctuations in unemployment, and as such should have a part in the progressive solution of the problem.

WILLIAM TRUFANT FOSTER
Editor of the Pollak Publications

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CYCLES OF UNEMPLOYMENT

In the United States

1903-1922

CYCLES OF UNEMPLOYMENT

In the United States, 1903-1922

THE purpose of this monograph is to answer the question, "What do the American figures on employment and unemployment show, as to the relation between unemployment and the business cycle?" A general answer may be given in a nutshell. The unemployment figures fail to tell us the actual number of persons unemployed at a given time — except with very large elements of error and guess-work which would spoil the results for any practical purpose. In this connection the reader may recall the wide variety of unemployment estimates in circulation at the time of the President's Conference on Unemployment, in the summer of 1921 — estimates ranging from two million to six million unemployed persons. But unemployment data,

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when taken in conjunction with the data representing the number employed according to pay-rolls, enable us to construct a reliable, continuous barometer or *index of employment cycles*.¹

¹ All notes are in the Appendix.

I

USES OF AN EMPLOYMENT INDEX

SUCH an index can be shown to have a definite value to various groups in the community, not only during depressions, when unemployment is rife, but also during more active times. The index of employment has four main uses:

1. Most directly, employment registers the course of the *labor market*; that is, it shows relatively how “easy” or how “tight” the labor market is at any given time, much as bank reserves reflect the state of the money market.
2. Employment is some indication of the general course of *production*, since the hiring and the firing of labor are largely resorted to by employers when they wish to increase or curtail output.
3. A third practical use is shown by the

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relation of employment to *buying power*. The total fund of purchasing power flowing into the hands of wage-earners at a given time is conditioned directly by the state of employment.

4. An equally important feature, shown indirectly by an employment index, is the cycle of *social welfare*. Largely as a result of fluctuations in the economic prosperity of wage-earners, there are found to be pronounced cycles of suicide, crime, prostitution, pauperism, marriages, migration, and other social problems.

In other words, the problem of cyclical employment stands in a position midway between the economic and the social phases of the business cycle; it is a connecting link. Consequently, a reliable index of employment may be expected to prove of more general use than would an index for any purely economic or purely social phenomenon. The

USES OF AN EMPLOYMENT INDEX

following analysis, therefore, concerns not only the public-spirited citizen, but even more tangibly and directly the social student and worker, and likewise the business man, whether he be interested chiefly in employment management, in production, or in sales.

What is an "index of employment"? It is a series of figures so constructed that its fluctuations will reflect changes in the *relative intensity* of employment between two points of time, without necessarily measuring the total *volume* of employment or of unemployment — or even the number of persons totally unemployed.² In other words, the index method should yield a continuous curve of employment, the high points of which represent active employment, the low points severe unemployment, and intermediate points the varying degree of seriousness of the problem.

By adopting this simple device we avoid

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several difficult problems in which we might have become entangled if we had chosen some other objective, such as that of attempting to measure the actual number of unemployed persons. A method followed by more writers than one is to take the "percentages unemployed" reported by trade-unions in certain States, as indicative of the degree of general unemployment. These percentages, multiplied by the total number of wage-earners supposed to be in the country at various Census dates, yield figures which are regarded as the number of persons unemployed at a given time. The results obtained by averaging over a period of time are supposed to give the number (or the percentage) "normally" unemployed in industry.³ Undoubtedly this method has at least the advantage of simplicity. It involves, however, highly precarious assumptions: the assumption, for example, that the original figures are accurate measures of the amount of unemployment in the

USES OF AN EMPLOYMENT INDEX

unions themselves, and the further assumption that these percentages hold true of the less skilled and very different kinds of labor among wage-earners outside the unions. In the opinion of the present writer, the errors probably involved in the various assumptions underlying this method are so serious as greatly to outweigh the advantage of simplicity.

A much more roundabout method, followed by another writer,⁴ is to regard the number of the unemployed as the difference between the "active supply" of urban labor and the "connected demand" for that labor. These two large aggregates are then estimated from data on employment, population, births, deaths, migration from and into the United States as well as between city and country, and other factors. *In conception*, this method is logical; but several of the variables involved are represented, in this country, by such scanty and inaccurate data as to make the solution of

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the problem by this method indeterminate *in practice*. Indiscriminate patching together of data so diverse in nature and accuracy cannot be expected to yield reliable estimates of either the aggregate volume of employment or of the aggregate labor-supply. Moreover, the process of subtracting one from the other of these two large and unreliable absolutes magnifies the importance of the errors. In other words, the percentage of error in the estimates of unemployment thus derived is likely to be even greater than the percentages of probable error in the two original quantities.

Neither of these methods, therefore, should be used in the problem now facing us. No doubt, any community could use to great advantage reliable estimates of the volume of unemployment or of the numbers unemployed; but at present there seems to be little or no possibility of obtaining reliable estimates. In this study, accordingly, the method of at-

USES OF AN EMPLOYMENT INDEX

tempting to measure the volume of unemployment is definitely rejected in favor of studying simply the *fluctuations* of employment and unemployment, regardless of their absolute volume.

II

GEOGRAPHICAL DISTRIBUTION OF INDUSTRY

BEFORE presenting the material for a general index of employment in the United States, it is well, first, to consider the economic importance of the leading States for which data on employment have been or now are available, in order to judge the adequacy of our samples; and, second, to pass in review the leading evidence upon which a general employment index may be based. This review is presented for convenience in two parts: for the period prior to June, 1914, and for the period since June, 1914.

The following table shows the proportion of factory wage-earners in the leading States for which employment data are available, or have been available within recent years. New

GEOGRAPHICAL DISTRIBUTION

York, which heads the list, contains between one sixth and one seventh of all the wage-earners in the country employed in manufacturing industries. This is equivalent to Massachusetts and Illinois taken together. It is equivalent to three New Jerseys or five Connecticut or Wisconsin. Of all the States in the country, New York is exceeded in manufacturing only by Pennsylvania, which has had no comprehensive employment data in recent years except for a short time early in the War.

Further economic considerations confirm the key position of New York in a study of employment. Such, for example, are its industrial diversification, its ready access to foreign markets and to supplies of iron, coal, and immigrant labor, together with its central geographical position in relation to other great industrial States. In short, New York State is both a large and a representative sample of the country's manufacturing activity.⁵

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GEOGRAPHICAL DISTRIBUTION OF WAGE-EARNERS EMPLOYED IN MANUFACTURING INDUSTRIES IN SELECTED STATES ⁶

(Unit: one per cent)

	1904	1909	1914	1919
New York	15 7	15 2	15 0	13.5
Massachusetts.....	8 9	8 8	8 6	8 0
Illinois.....	6 9	7 0	7 2	7 2
New Jersey	4 9	4 9	5.3	6.6
Connecticut.....	3 3	3.2	3.2	3 2
Wisconsin.....	2 8	2.8	2 8	2.9
United States	100.0	100.0	100.0	100.0

Bearing in mind the differences among the States in industrial importance and position, we may review in succession employment indexes constructed from the available data.

III

INDEXES OF EMPLOYMENT, 1903-1914

A

Employment in Massachusetts and in New Jersey

CHART 1 shows two indexes of employment derived from the pay-roll data of manufacturing establishments in New Jersey and Massachusetts. Since our purpose is to isolate the *cycles* of employment, we have first eliminated from the crude employment data the long-time trend due to the growth factor in industry, just as we should have had to eliminate the growth of population in isolating the cycles of foreign trade or of pauperism. Besides the long-time trend we have eliminated the rather marked seasonal variation of employment, as we should have to do in studying cycles of wheat production, or of domestic coal consumption for heating purposes.

CYCLES OF UNEMPLOYMENT

After eliminating these two types of variation, as being irrelevant to the purposes of this monograph, we naturally find that the horizontal base-line of Chart 1 measures *normal* employment, and the fluctuations above and below it represent pure *cycles* of employment.⁷ One may therefore read from the scale at the right the net deviation from normal, attributable in any given month to the cycle of business conditions. The upper part (positive deviation) of these curves represents good employment; the lower part (negative deviation) represents relatively poor employment.

The scale at the right represents these deviations in *percentages*. At the left of the first chart, one may read the fluctuations in terms of the typical, or "standard," percentage deviation from the base-line, rather than in units of one per cent. The *standard deviation* for both these curves happens to be the same (3.4 per cent). By using for a vertical

INDEXES OF EMPLOYMENT, 1903-1914

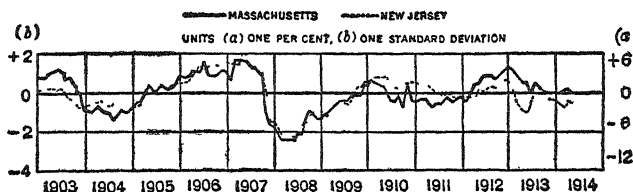


CHART 1
EMPLOYMENT IN FACTORIES, 1903-1914

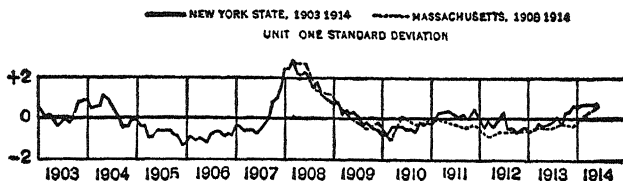


CHART 2
UNEMPLOYMENT IN TRADE-UNIONS, 1903-1914

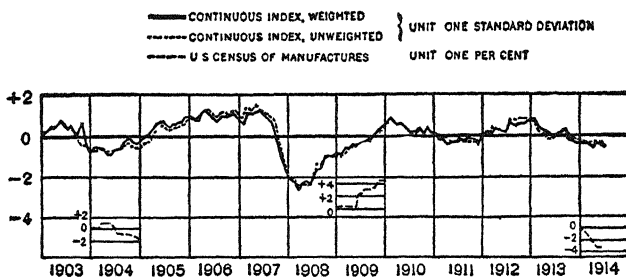


CHART 3
GENERAL INDEXES OF EMPLOYMENT, 1903-1914

(Units: for continuous curves, one standard deviation; for Census fragments, one per cent measured from January of current year)

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unit the standard deviation rather than the percentage, we gain this important advantage: comparison is made easier between curves having unequal standard deviations, for instance, between the curves in Chart 1 and those in Chart 2. In view of this advantage, the standard deviation is used as the vertical unit for most of the curves shown in this monograph.

The Massachusetts curve is derived from data collected from employers early in each year by the Massachusetts Bureau of Statistics. These data show the number of wage-earners on pay-rolls at the middle of each month in the most important manufacturing establishments of the State.⁸ The number of wage-earners covered by these reports has formed a large part of the total number employed in manufacturing within the State, having ranged from one hundred and fifty thousand to eight hundred thousand, or from eighty per cent upwards.⁹

INDEXES OF EMPLOYMENT, 1903-1914

An important peculiarity of manufacturing in Massachusetts is the degree of industrial specialization. Cotton manufacturing, the boot and shoe industry, woolen and worsted goods, and foundry and machine-shop products together comprise forty to fifty-five per cent of all manufacturing in Massachusetts. Specialization is one of the factors that render the Massachusetts returns imperfectly representative of general industrial conditions. Moreover, cotton manufacture, which is the most important of all, is wholly dependent upon agriculture for its raw material, and an especially large or small cotton crop seriously affects the response of the industry to the business cycle. Moreover, in several of the leading industries women and juveniles are heavily employed.¹⁰ As disconnected local censuses of manufactures, year by year, these Massachusetts data are excellent; but, as a continuous record of employment fluctuation, they cannot be safely accepted without res-

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ervation. The curve in Chart 1 probably shows as reliable a continuous index for Massachusetts as can well be constructed from these fragments.¹¹

A word may be said in passing as to the data represented in the second curve on Chart 1, picturing employment cycles in New Jersey. From 1893 until 1918, the New Jersey Bureau of Industrial Statistics collected data similar in nature to those just described for Massachusetts. The scope of the material, at first limited to about fifty thousand wage-earners,¹² was considerably enlarged in subsequent years, running as high as five hundred thousand in 1918. Here, as in Massachusetts, the canvass did not cover a fixed proportion of establishments, nor even a steadily increasing proportion, but generally between seventy-five and ninety per cent. Thus, in 1899, an average of one hundred and seventy-five thousand wage-earners was represented; that is, eighty-two per cent of the number shown

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by the Federal Census of Manufactures. The ratio fell to seventy-seven per cent in 1904, then rose to eighty-seven per cent in 1909, and to eighty-eight per cent in 1914.

New Jersey is industrially more diversified than Massachusetts. The machinery and metal working industries are fairly strong; wool, silk, tobacco, and several other industries also rank comparatively high. It is noteworthy that cotton manufacture ranks eleventh, representing only about two per cent of all New Jersey's manufacturing, as contrasted with fifteen to twenty-five per cent in Massachusetts. This is a second point of superiority over the Massachusetts figures.

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B

Unemployment in New York and in Massachusetts

ONE can also obtain highly valuable evidence as to employment fluctuations by examining fluctuations in unemployment, "the other side of the shield." Before the War, two useful unemployment series were available : one for Massachusetts, and one for New York State. Each was reported in fairly consistent form, without sudden changes from year to year as in the pay-roll data; consequently the two unemployment series have in common the advantage of continuity. They have a second advantage in greater breadth of industrial scope, for they comprise not only manufacturing, but also building and transportation. Both the unemployment series are valuable. Each has its own points of merit, but that for New York has a net advantage for the present purpose, since it is reported monthly instead of quarterly, extends over

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a pre-War period twice as long as that for Massachusetts, and covers a much more important and more favorably situated industrial State.

It is, of course, impossible to utilize these figures in their original form, owing to the effect of disputes, seasonal variation and long-time trend, as well as more subtle factors such as changes in industrial composition. A suitable method of analysis has eliminated these difficulties,¹³ yielding the two unemployment indexes shown in Chart 2.

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C

Comparison of the Evidence

By comparing with each other the two curves in Chart 2, and contrasting these with the pair shown in the first chart, the reader will readily see that in almost every instance the unemployment curves rose when the employment curves fell, and *vice versa*. The two kinds of data show a high order of agreement, as to the course of employment cycles in the dozen years before the War. Only minor discrepancies in the course of the four curves are to be found. For example, after the depression of 1903-04, and again after the prolonged boom of 1905-07, a turn appeared in the New York curve slightly earlier than in the others. The discrepancy in 1904 was probably due to the peculiar effect of a "tandem revival" from the depression caused by the "Rich Man's Panic" in 1903. One revival, a brief and abortive one, took place early in 1904, was

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followed by a distinct slump, then by a more pronounced recovery lasting into 1907. This reflex action, indicated also by other industrial barometers like pig-iron production, and by notes in the trade journals of the time, stands almost unparalleled in American experience. With such sudden reversals of the industrial machine, it is not surprising that dissimilarities should be found in different States during the year 1904.

The slightly earlier increase of unemployment in New York in 1907 is likewise attributable to business conditions, not to any feature peculiar to the unemployment curve as such. For instance, the bank clearings of cities in New York State outside the metropolis are found, upon analysis, to follow the same course as the inverted unemployment curve. In other words, they precede slightly the clearings cycles for other parts of the country, in the decline of activity leading to the depression of 1908.

CYCLES OF UNEMPLOYMENT

The degree of the similarity, or excellence of fit, among the four curves of Charts 1 and 2 may be measured numerically, by determining the "correlation coefficients" or "coefficients of similarity" between each two series. These coefficients are simply numbers derived from all the items of the two compared series, by a mathematical formula so contrived that +100 per cent, or +1.00, represents perfect agreement, 0 represents non-agreement, or lack of correspondence, and -100 per cent, or -1.00, represents perfect *inverse* correspondence. Experience has shown that correlation coefficients signify approximately the following degrees of correspondence between two economic time-series:

Below 0.50, very low

From 0.50 to 0.60, rather low

From 0.60 to 0.70, fair

From 0.70 to 0.80, good

From 0.80 to 0.90, very good

Over 0.90, excellent¹⁴

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In the case under consideration, the coefficients of correlation are as follows: between the two unemployment indexes, $+0.72$; between New York unemployment and New Jersey employment, -0.73 ; between New York unemployment and Massachusetts employment, -0.80 ; and between Massachusetts employment and unemployment, -0.88 . In each case the correlation is found to be greatest for simultaneous items. In other words, when we correlate the items of one series with those for another series *with a lag or a lead of one month*, we find smaller coefficients than when each set of items is matched with the exactly simultaneous items of another set. We are, therefore, justified in saying that in general the four curves resemble each other very closely in timing as well as in form. None tends systematically to precede or to follow any of the others.

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D

A General Index of Employment Cycles

WE now have before us all the materials necessary for constructing a monthly general index of employment cycles for the United States from 1903 to 1914. The three States represented in Charts 1 and 2 comprise a fairly large sample: New York, 14 per cent; Massachusetts, 8 per cent; and New Jersey, 5 per cent; a total of 27 per cent, or more than one fourth of all the industrial wage-earners in the United States. The indexes appear to represent adequately the course of employment cycles in the respective States, and they support each other so thoroughly as to justify beyond any reasonable doubt a combination of the three, first "tipping upside down," or reversing in sign, the two series of *unemployment* cycles, in order that they may directly measure *employment* cycles.

Two such combinations are presented in

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Chart 3. Both are based upon the two employment indexes and the inverted unemployment index for New York.¹⁵ In the weighted index (full line), the three components are assigned weights of five points (New York), three points (Massachusetts), and two points (New Jersey), in proportion to the actual industrial importance of the three States,¹⁶ on the assumption that the indexes properly represent employment in their respective States. An unweighted average was also constructed, allowing equal influence to each of the three State indexes. The result, shown by the dotted line in Chart 3, nearly coincides with the weighted index. The correlation coefficient is $+0.99$. The close agreement between the weighted and unweighted composites shows that accuracy in weighting is of only slight importance, owing to the similarity of the three components.

At this point some valuable supporting evidence from the United States Census of

CYCLES OF UNEMPLOYMENT

Manufactures may be introduced. These are monthly data covering virtually all industrial wage-earners in the United States, in the census years 1904, 1909, and 1914.¹⁷ They form by far the most comprehensive employment data we have, covering in 1904 five million, and in 1914 seven million wage-earners. It should be noted that each of the leading manufacturing industries has maintained its quota of the total, throughout the period, in such a stable manner that the data may be regarded as industrially homogeneous from census to census. In not more than three cases (vehicles for land transportation, railroad repair shops, and the miscellaneous group) has there been any decisive increase, while in only two cases (lumber and its products, and leather and its products) has there been a decline. In all the other groups, quotas have remained constant.¹⁸

Although no similar data are available for intercensal years, it has been possible with

INDEXES OF EMPLOYMENT, 1903-1914

the aid of a special method ¹⁹ to eliminate most of the seasonal variation and long-run trend in these data, and thus to obtain a fragmentary idea as to the course of the employment cycle during these three years. The results are shown by the segments at the bottom of Chart 3. Inspection shows that, on the whole, these Census data strongly confirm the continuous index based on the three-State sample.²⁰

IV

INDEXES OF EMPLOYMENT, 1914-1922

WE are now in position to show to what extent the employment data being currently reported justify the construction of an index to be used in the study of current economic fluctuations. Does the subsequent course of employment confirm the findings derived from a study of the period from 1903 to 1914?

The *economic* reasons for breaking our study into two parts — that before and that since the outbreak of the War — will be readily apparent to any thoughtful reader on a moment's reflection; and they need not be recited here. There are also *statistical* reasons for breaking the study at 1914. The best of the current employment indexes were not begun until the early part of the War. One of these is the index representing employment in manufacturing establishments of New

INDEXES OF EMPLOYMENT, 1914-1922

York State, which was begun in June, 1914. Another, similar to this, is the series of the United States Bureau of Labor Statistics, begun in October, 1915. Early in 1915, the Wisconsin Industrial Commission began to collect employment data at quarterly (later monthly) intervals; and under the stress of business depression similar series have been started, during 1921 and 1922, in several other States — notably Illinois, Iowa, and Connecticut. In January, 1921, the United States Employment Service also began a series, collected like that of the Bureau of Labor Statistics from manufacturing establishments in a large part of the country. We may now pass to a review of the evidences, and determine whether a general index of employment can be reliably constructed for the War and post-War period.

CYCLES OF UNEMPLOYMENT

A

Three State and Federal Indexes

IN Chart 4 are shown three semi-adjusted indexes,²¹ and one wholly unadjusted series. The first curve represents, in semi-adjusted form, the employment index of the New York State Industrial Commission. This index includes on the average about a half-million wage-earners. Although restricted geographically, it is well planned in industrial composition. Especially significant is the fact that machinery, iron, and steel form an influential component of this index, because — as has been shown elsewhere²² — employment fluctuations in the metal industries register very accurately the timing of fluctuations in other lines of industrial activity. Moderately overweighting the metal group is therefore more advantageous than otherwise.

The second curve represents the semi-adjusted indexes based upon the “link-rela-

INDEXES OF EMPLOYMENT, 1914-1922

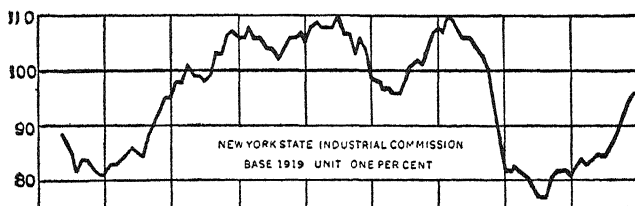
tives" — that is, the changes between each two successive months — as reported by the United States Bureau of Labor Statistics in its *Monthly Labor Review*. These data have been compounded into series of "chain-relatives," which in turn have been combined for the several industries,²³ using weights proportional to the importance of the industries according to the 1914 Census of Manufactures. Finally, the weighted chain-relatives for the combination of industries have been reduced to the average for the census year 1919 as a base.

This series has several points of merit. Although planned with prime reference to industries rather than States, its geographical composition is fairly broad, and it covers the largest manufacturing States. The industrial make-up of the series is somewhat peculiar. In the distribution of the six hundred thousand to eight hundred thousand wage-earners actually embodied in the returns, the automobile,

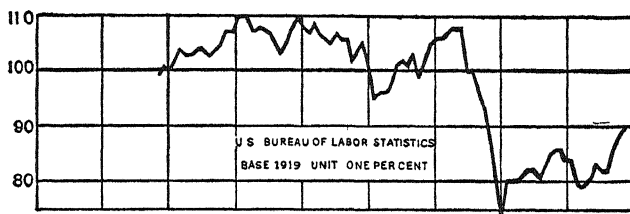
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iron and steel, and car-repairing industries are represented strongly, textiles and others lightly; but the process of weighting by the Census of Manufactures turns the tables, greatly reducing the emphasis on metal industries and stressing the textiles. The reason is that, unintentionally, the groups have been so selected that those related to textiles have a weight of about forty-five per cent, and those falling under metals about thirty-five per cent. This selection gives a much stronger representation to the textile industry than is justified by the Census of Manufactures, in which this industry amounts to only twenty-one per cent of all manufacturing. The objection to this employment series is simply that too many of both the textile and the metal industries were represented, and too few of the diverse minor industries of the country.²⁴ Such weighting is not well suited to the restricted list of industries used, owing to the considerable difference between crop cycles

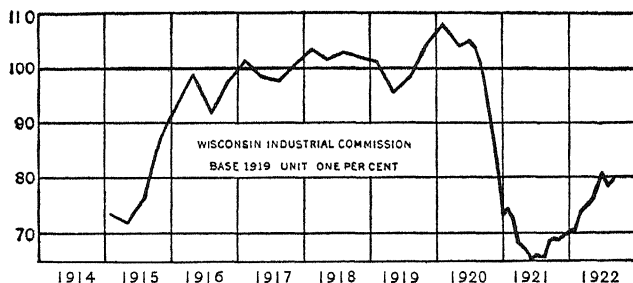
INDEXES OF EMPLOYMENT, 1914-1922



A. Employment in New York State factories



B. Employment in factories located in various States



C. Employment in Wisconsin factories

CHART 4. UNADJUSTED INDEXES OF EMPLOYMENT, 1914-1922
(Base: 1919 average; unit: one per cent)

CYCLES OF UNEMPLOYMENT

and business cycles. But instead of attempting a revision of the Bureau of Labor index, we have largely corrected the fault by a simpler method, as will appear presently.

The first two curves in Chart 4 show, on the whole, a remarkably close agreement in both timing and amplitude. Each of the discrepancies noted is almost wholly attributable to differences in the industrial distribution. Textiles are represented very strongly in the Bureau of Labor index, but less strongly in the New York index, in which metals, machinery, and so forth, outweigh textiles and their products.

The employment curve for Wisconsin fluctuated in nearly the same manner as the others shown in Chart 4, except that the vertical amplitude of its movement in the recent depression is somewhat greater. In form, the Wisconsin index more closely resembles the index for New York than that for the United States, chiefly because in Wis-

INDEXES OF EMPLOYMENT, 1914-1922

consin, as in New York, the metal industries are heavily represented.²⁵

Employment in New Jersey increased during the War in much the same manner as in other States, although this State was relatively more affected by the expansion of War industries—munitions, chemicals, and explosives—than were most States. The New Jersey data were not continuous between calendar years, and they were discontinued altogether in 1918, so that the available fragments are not sufficiently useful in setting up a current index of employment, and are not charted.

Another index not shown in the chart is that established in January, 1921, by the United States Employment Service, but recently discontinued before it had covered a period long enough to enable us to test its merits empirically. In general it followed a course not unlike the New York and Wisconsin indexes during 1921. Apparently the series had some merit. It covered about one

CYCLES OF UNEMPLOYMENT

and one half million wage-earners, a larger number than any other index except the recently revised index of the Bureau of Labor Statistics. Its industrial composition, though imperfect, was on the whole well planned and fairly representative of manufacturing in the United States. The chief features of its industrial composition were that the iron and steel group was somewhat overweighted, textiles were underweighted, vehicles greatly overweighted, and lumber greatly underweighted. This series had the great advantage of timeliness in reporting, for current data were published considerably earlier than those for other series, being telegraphed by the District Directors of the Service, and announced shortly afterward by the central office at Washington. It must be admitted, however, that there was a correlative disadvantage: some of the basic reports seem to have been gathered by the Directors from the employers by such methods, and in such

INDEXES OF EMPLOYMENT, 1914-1922

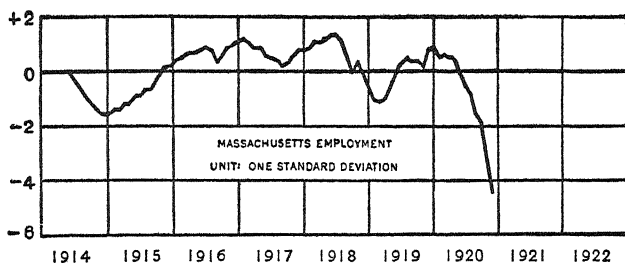
haste, as to cast doubt upon the results. Though undoubtedly defective in several respects, this index had some features which might well be emulated by other employment reporting agencies.

CYCLES OF UNEMPLOYMENT

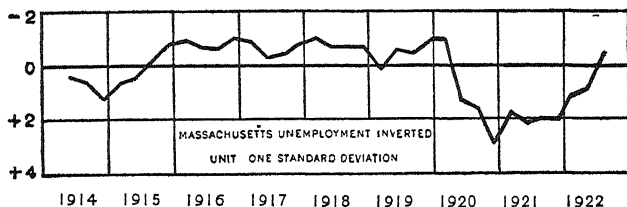
B

Three Adjusted Indexes

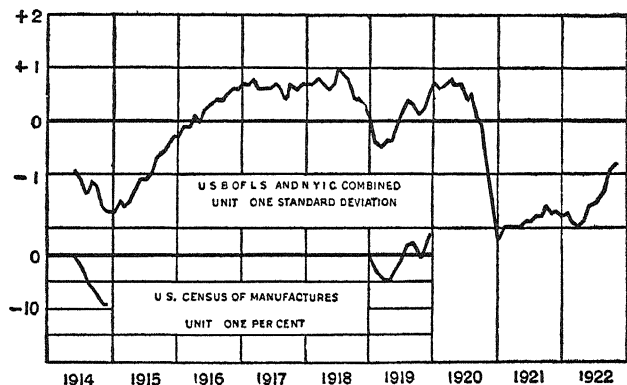
IN Chart 5 are shown some fully corrected indexes of employment and unemployment available during and since the War. The first curve represents the adjusted employment cycles in Massachusetts through 1920, the latest year for which complete data are now available (February, 1923). The second curve represents the corrected cycles for Massachusetts *unemployment inverted*.²⁶ The third index probably constitutes the most reliable current measure of the general employment cycle in the United States that can readily be constructed, in our present state of knowledge. It is the average of the employment indexes of the United States Bureau of Labor Statistics and the New York Industrial Commission, corrected for seasonal and other variations, like the first two curves on Chart 5. At the foot of Chart 5 are shown



A. Employment in Massachusetts factories



B. Unemployment in Massachusetts trade-unions (inverted)



C. United States Bureau of Labor Statistics and New York State Indexes, combined

CHART 5. ADJUSTED INDEXES OF EMPLOYMENT, 1914-1922

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the fragments representing the United States Censuses of Manufactures in 1914 and 1919, corrected for seasonal variation in the same manner as the pre-War fragments shown at the foot of Chart 3.

The high order of correspondence among these curves is indicated by the following coefficients of correlation: United States Bureau of Labor Statistics series with New York Industrial Commission series (1915-21) $+0.95$; unadjusted combination of these two, with Wisconsin series (1915-21) $+0.98$; adjusted combination, with Massachusetts employment series (1914-20) $+0.80$; adjusted Massachusetts employment and unemployment series inverted (1914-20) $+0.89$. The Census data support very well the combination of the two series showing correlation coefficients of $+0.79$ for June-December, 1914, and $+0.97$ for the twelve months of 1919. Here, as in the pre-War comparison, the agreement is close in vertical

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amplitude, as well as in direction, form, and timing.

Why should the proposed current index be made up of the Bureau of Labor data and the New York data alone? The choice hinges on the purpose in view. Our present purpose is to construct an index with the following properties :

- (a) its components must have been reported in a comparable form for a sufficiently long period to establish a basis for empirical test, comparison, and appraisal;
- (b) it must be reasonably representative, industrially and geographically ; and
- (c) its components must be reported currently, in monthly form, with reasonable promptness, and with accuracy.

Among all these series, only the above-mentioned combination meets the three tests. The Massachusetts employment series lacks the third property, since the monthly figures

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for each year are not known until long after the end of the year. The unemployment data for Massachusetts appear at quarterly, not monthly intervals. The New Jersey series is defunct. The Employment Service data fail to meet tests (a) and (c).

Considering the indexes of the New York Industrial Commission and of the United States Bureau of Labor Statistics, we find that each satisfies test (a) better than do any others now reported. The latter satisfies admirably the test concerning geographical representation, and—judging by the industrial position of New York, and the findings concerning employment in the pre-war period—the New York index should also be highly representative of the industrial States.

Each of these indexes fails, *when taken alone*, to meet the first half of test (b), since the former has been shown to overstress metals, and the latter textiles. This failure is largely

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remedied by the mere process of combination: the textile and the iron industries are thereby restored more nearly to their true relationship. The groups including textiles, and those including iron and steel and their products, both enjoy in the composite index a weight somewhat, though only moderately, in excess of their true importance.

In the light of all these facts, there is a very strong probability that the average of these two series shows the consensus of monthly employment fluctuations in the United States in recent years better than would any other readily constituted index. The homogeneous and continuous nature of this combination forms an important advantage. In support of its validity, one may observe that even if we did include in the average other series covering parts of the period 1914-22 as shown in Charts 4 and 5, only slight differences from the average here shown would result.

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C

Interpretation of the Fluctuations since 1914

ACCORDING to the corrected index based on these two series, employment has passed through some interesting phases during the past eight years. The fluctuations may be attributed in part to the business cycle and in part to other factors, notably the changing situation as to immigration and the military demand for men. The depression of 1914-15, the war boom of 1916-18, the relapse during the half-year after the Armistice, the boom of 1919-20, the acute depression of 1920-21, and the subsequent recovery are, in a measure, reflections of the change in the demand for production, and therefore in one sense simply a passive factor in the business cycle. But during the War employment became a potent limiting factor.

Our entry into the War introduced new forces into the industrial situation; in addition

INDEXES OF EMPLOYMENT, 1914-1922

to war demands by our own Government for goods, there was a direct call for man-power for use in military operations. Military need for men affected the labor market enormously for a period of twenty months — from the spring

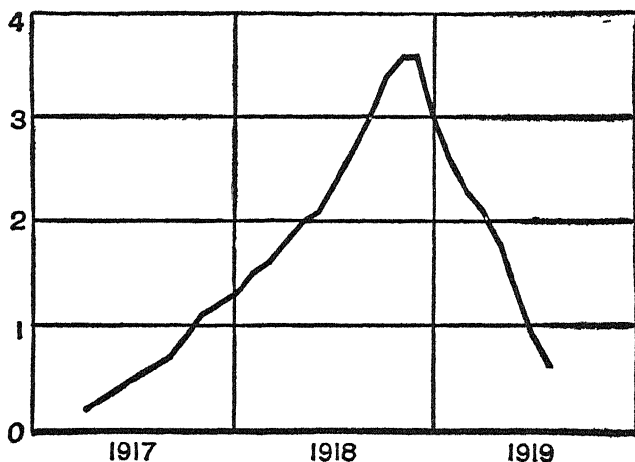


CHART 6. PERSONNEL OF U. S. ARMY, April, 1917 - August, 1919
(Unit 1,000,000 men)

of 1917 until the latter part of 1919. During that time the labor-supply became one of the factors which drastically affected economic activity. Enlistments, which increased immediately after our entry into the War, were

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supplemented in the late summer of 1917 by the first increment of the draft, and in 1918 by several additional increments amounting to about two and a half million more men. The rapidly increasing drain of man-power from civil life is shown by Chart 6, representing the total army personnel by months.²⁷ The number increased from two hundred thousand to more than one million before the end of 1917, and to three million six hundred thousand at the time of the Armistice. It finally attained a rate of increase of four hundred thousand men a month.

These figures fail to tell the absolute magnitude of the loss of industrial wage-earners from civil life, because many hands were engaged in war work outside of the army and navy. They do, however, show fairly well the increasingly rapid rate of change in the supply of available man-power, and consequently account for some of the dents in the employment curve. Undoubtedly, these dents would

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have been much deeper but for the heavy influx of women, youths, and young girls from home and school into industry, as well as that of adult male labor transferred from normal occupations in office or farm work to certain lines of manufacturing, under the double attraction of high wages and a deferred classification in the draft.

Demobilization shows an illuminating but quite different relation to the employment index. During the first six months after the Armistice, discharges took place at twice the average monthly rate of mobilization, reducing the strength of the army from three million six hundred thousand to two million by April, and to one million before July, 1919. The discharge of enlisted men alone averaged four hundred thousand a month during the first half of 1919.²⁸ It is evident from a comparison of Charts 5 and 6 that most of this huge labor-supply was being dumped on a falling market. At the time when employers

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were rapidly dismissing their employees in the post-Armistice slump, soldiers were being discharged from the army. At the bottom of the slump,²⁹ in midsummer of 1919, two million soldiers had been discharged, several hundred thousand of whom must have remained unemployed for months before being reabsorbed in industry. The situation disclosed by the two curves probably accounts in part for the prevalent impression that the soldiers returning in 1919 "did not want to work." Apparently, lack of the opportunity to work was also a potent factor.

If the relapse of 1919 had not been fairly brief, there would have arisen in very urgent form the question whether the demobilization policy allowed a rate of discharge so rapid that it hampered proper industrial reabsorption and precipitated a needless unemployment crisis.³⁰ However, the labor-supply withdrawn from the market by military demands was restored so soon after the War

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that, when the recovery came in 1919-20, industry could proceed unchecked by such potent labor limitations as had prevailed in the two preceding years, and without need of resorting so widely to inexpert labor from other fields.

The severity of unemployment in 1920-21 may be compared roughly with that in earlier depressions, by noting the relative amounts by which employment falls off between a boom and the succeeding depression within each business cycle. The accompanying list shows that the available indexes of employment in manufacturing industries responded more violently to the recent depression than to earlier ones.

<i>Peak of boom</i>	<i>Bottom of depression</i>	<i>Approximate decline of employment</i>
Middle of 1903	Middle of 1904	5 points
Middle of 1907	First quarter 1908	15 points
Early — 1910	Middle of 1911	5 points
Early — 1913	Late in 1914 and early in 1915	10 points
Third quarter, 1918	Second quarter, 1919	15 points
Early — 1920	First half of 1921	25-30 points

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It is possible, but unlikely, that much of this difference is due to differences in composition between the current and the earlier indexes. There seems good ground for believing that, in actual diminution of employment, the depression of 1921 was almost twice as acute as that of 1908, and more than twice as acute as that of 1914-15.

V

EMPLOYMENT CYCLES AND PRODUCTION

ONE of the possible functions of an employment index mentioned at the beginning of this study is its use as a barometer of industrial activity. In the economic sense, production should prove to be one of the most intimate correlatives of employment cycles—more intimate than prices, for example, because profit and price *actuate*, but they do not *measure*, current industrial activity. The relation of production to employment may be demonstrated by comparing the monthly employment index with a monthly index of production.

Unfortunately, until recent years, production data were available in monthly form for only a few manufacturing lines. One of the most comprehensive studies of these monthly production data is that of Professor Edmund

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E. Day. Chart 7 shows his "unadjusted index" for the period since January, 1919, covering production in a large number of lines of manufacture. Compared with it is the

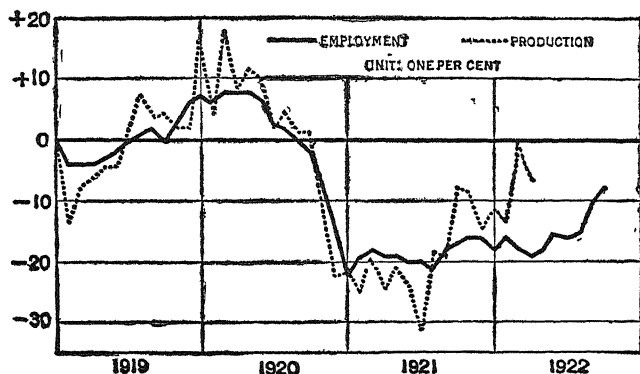


CHART 7
UNADJUSTED INDEXES OF EMPLOYMENT AND PRODUCTION
1919-1922

writer's employment index, likewise uncorrected for seasonal and other variations.

Throughout the years here covered, the curves representing employment and production show change of direction at nearly the same time. Every critical movement is shown with almost equal clearness in both

EMPLOYMENT CYCLES AND PRODUCTION

curves; the relapse after the Armistice, the recovery in the second, third, and fourth quarters of 1919, the culmination of the boom early in 1920, the ebb of prosperity, at first slow, then precipitate, lasting until the middle of 1921, and the gradual but genuine improvement since that time. The correlation coefficient (1919-21) is $+0.96$.

Four significant differences between the curves appear; let us examine them in order.

1. The employment and production indexes differ somewhat as to the precise date when the recent depression "scraped bottom," and as to the course of the subsequent recovery. The employment index reached its lowest point in January, 1921, then showed moderate improvement until the set-back in the winter of 1921-22, and a more decisive increase subsequently. The production index showed a conspicuous

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“dent” in January, 1921, but continued its decline until July, and has risen steadily ever since, except for occasional retardation due to labor troubles and other causes.

This difference is due in part to mere differences in industrial composition of the two indexes: there is ground for the belief that during the latest business cycle there has been unusual diversity among the industries, in the timing and form of their activity-curves. Another factor—probably much more important than this—is the comparative preponderance of capital or producers’ goods in the production index, and of finished or consumers’ goods in the employment index, as will be pointed out more at length in the following paragraphs. Indeed, the index recently constructed by Professor Day for the volume of manufacture of *consumption goods* differs from the manufacture of *production*

EMPLOYMENT CYCLES AND PRODUCTION

goods in almost the same manner as does the employment index, in respect to timing. One further factor which throws a side-light on these differences is the pronounced increase in labor-efficiency reported from many quarters during the latter part of the depression. So decisive was this improvement that not infrequently an employer has found that the laying-off of help was accompanied by an *increase* in the aggregate output of the factory! These three factors go far to account for the outward differences in behavior of the two indexes during 1921 and 1922.

2. Unlike production, the employment index was unaffected by the varying lengths of the months. For instance, in February the volume of production tended to slump below that of the preceding month, owing primarily to the ten per cent difference in the number of days included. Until corrected for

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seasonal variation, the production index, therefore, represents less accurately than employment the true variations in the *intensity* of industrial activity.

3. The employment curve was in general much less disturbed than the production curve by strikes—for example, those of September to December, 1919, and the winter of 1921. Partial explanation for this may be found in the fact that the supply of basic materials, the chief constituents of the production index, was affected much more by these labor disturbances than was the manufacture of semi-finished and finished goods. These latter could more readily maintain themselves during the interval, presumably on a carry-over of raw materials. Moreover, manufacturers and other employers doubtless hold over their labor force during the temporary shortages of raw materials incident to

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labor disputes in key industries; at least, this is likely when the dispute occurs at a time of marked prosperity such as the autumn and winter of 1919-20.

4. A fourth difference is that the production curve, if the temporary effect of these labor disputes be smoothed out, may be seen to have risen to a greater height in the boom of 1919-20, and subsequently to have fallen to a greater depth than did the employment curve. Employment rose only about eight per cent above its average, but production increased twice as much. In the depression of 1921, employment fell only about twenty per cent, but production fell about thirty per cent, below the average for 1919. The standard deviations of the two series for the period 1919-21 were 9.9 per cent and 14.3 per cent, respectively. In other words, the production index fluctuates over a

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wider vertical range than does the employment index.

This difference in the “amplitude” of the two indexes is extremely important. To what is it due? One cannot get conclusive evidence on the point, but at least three considerations may be shown to bear upon it. First of all, employment data are based on the number of employees on pay-rolls, and in such data no distinction is made between workers who are engaged part-time, full-time, and over-time. They therefore *understate* the real extent of labor activity in prosperity, since over-time work does not increase the number of employees on pay-rolls; they also *overstate* the extent of activity in depression, since part-time work does not decrease the number on pay-rolls.

To a certain extent this tendency is counterbalanced by a second consideration—fluctuations in the efficiency of labor. There is little

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or no numerical evidence on this point, but ordinary reasoning affords some light. During prosperity labor-efficiency is likely to diminish, partly because of the industrial fatigue due to speeding and working over-time, partly because of indifference to duty in the face of plentiful opportunities for work in other establishments, and partly because of the hiring of untrained or inferior workers. During a depression the situation is reversed in all these particulars. The efficiencies of productive factors other than labor—such as capital and industrial enterprise—likewise affect the net efficiency of industry as a whole; and they, too, doubtless fluctuate in relation to the business cycle. The considerations which probably govern these latter relationships are doubtless more obscure than those outlined above for labor-efficiency, and no attempt is here made to cover them. It is not impossible that the composite efficiency of industry in general may even increase, rather than de-

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crease, during the transition from depression to boom — despite the likelihood of an opposite tendency in the efficiency of labor. Such a situation is especially likely when industry is being worked at just “full load,” that is, before entering the over-load stage of the boom proper. It appears probable, however, that during the bottom of a depression and the peak of a boom, the efficiency or inefficiency of labor, rather than that of the other productive agents, would tend to be the determining factor.

A third consideration bearing upon the difference in amplitude is the fact that the production index is necessarily derived, in large measure, from data on the production of simple basic materials such as textile fibers and steel ingots, rather than more complex goods such as clothing and machinery. The reason is that, in the more advanced stages of manufacture, units of output are so varied and complex that few reliable data on production

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at these stages can as yet be obtained. The employment data, on the other hand, are collected from establishments working on products of all grades of complexity, and at all stages of fabrication. It seems probable, in the light of investigations recently made by Professor Day and others, that the production of basic materials or "producers' goods" responds more decisively to the course of the business cycle than does the production of finished or "consumers' goods." ³¹ If this be so, the production curve will naturally tend (other things being equal) to swing through a greater range of variation than will the employment curve.

A review of these three general considerations shows that changes in labor-efficiency would lead to a *wider* range of vertical fluctuations in the employment curve than in the production curve. On the other hand, the existence of over-time and part-time work, and the probably greater sensitiveness of the

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production of basic than of finished materials, would lead to a *narrower* range of fluctuations in the employment curve — such as Chart 7 actually shows. Incomplete allowance for “mushroom establishments” also tends to reduce the amplitude of the employment boom. The New York Industrial Commission definitely excludes these by covering in general only establishments which reported in June, 1914; the United States Bureau of Labor Statistics does not. Although little can be said as to the relative importance of these various factors, probably the failure of employment data to take account of over-time and part-time work is the main reason for the narrower range of fluctuation in the employment curve.

Chart 8 shows the employment and production indexes fully corrected for seasonal and other variations. Here, as in certain earlier charts, the inequalities in the vertical amplitude of the two curves have been lessened by

EMPLOYMENT CYCLES AND PRODUCTION

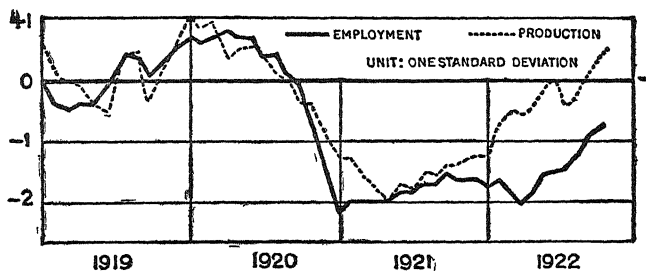


CHART 8. ADJUSTED INDEXES OF EMPLOYMENT AND PRODUCTION
1919-1922

using the standard deviation as the vertical unit. Chart 9 shows the employment index thrown into annual form and extended back to 1899. It is constructed by weighting the New York, Massachusetts, and New Jersey data, on the 5-3-2 basis.³² The curve is shown for comparison with Professor Day's annual production index for all manufacture.³³ The correlation, represented by a coefficient of $+0.86$, is high.

These two agreements — in annual form before the War and in monthly form since the War — are very close despite the differences in the source and nature of the two

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groups of data. The high order of agreement suggests the possibility of utilizing employ-

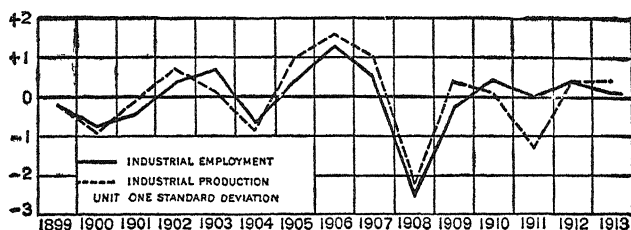


CHART 9. EMPLOYMENT AND PRODUCTION, 1899-1913

ment as an index of the monthly production cycles prior to the War. Since very few production series other than that for pig iron were available in monthly form at that time, employment provides a much more comprehensive basis for picturing the monthly pre-War cycles of industrial activity than can be obtained from evidence as to production. The employment index covers not only a much wider variety of lines, but more advanced stages of fabrication than could be represented in a pre-War index based on monthly production data.

EMPLOYMENT CYCLES AND PRODUCTION

Chart 10 shows the monthly index of employment compared with pig-iron production. Here again the agreement is very close ($+0.89$). Further substantiation of the validity of employment as an index of business

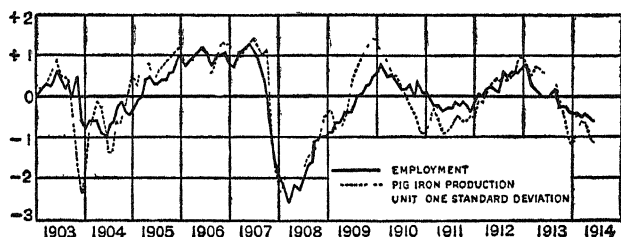


CHART 10

EMPLOYMENT AND PIG IRON PRODUCTION, 1903-1914

activity is found in the relations of employment to other series representing the volume of business,³⁴ such as bank clearings outside New York City. These relationships afford conclusive evidence, in support of that here presented, that employment yields a highly satisfactory index of industrial cycles both before and since the War.

VI

EMPLOYMENT CYCLES AND BUYING POWER

THE employment index is useful, not only as a guide to the labor market and to the course of industrial activity, but also to fluctuations in buying power. As measured in dollars, the volume of purchasing power, P , flowing into the hands of industrial wage-earners at any given time obviously depends partly upon the average fullness of employment, E , and partly upon the average rate of remuneration, R . Stated symbolically, $P = E \times R$. Now, obviously, any shrinkage of employment tends directly to curtail the current earnings, and therefore the effective demand, of the working group involved; and this curtailment of demand may lead to further shrinkage of employment in other lines, then to further curtailment of demand, and so on. In every depression this vicious circle rapidly spreads

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until it involves, directly or indirectly, a large part of the urban population. During business improvement the opposite course of developments naturally tends to prevail.

Employment affects buying power, not only through this direct influence on the volume of earnings, but also indirectly through

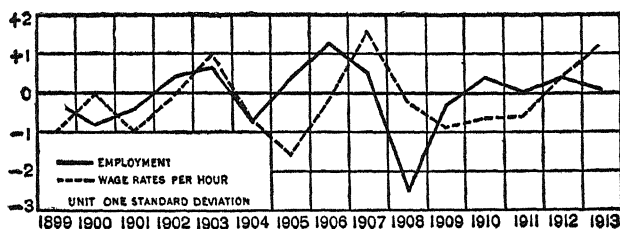


CHART II
EMPLOYMENT AND WAGE-RATES, 1899-1913

its influence on the rise and fall of *wage-rates*. When employment is active, and labor is scarce in relation to the demand for it, its price will naturally tend to rise. But when unemployment prevails and labor becomes relatively plentiful, reductions in wage-rates are in order. Chart 11 shows the relation

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between cycles of employment and of wage-rates,³⁵ from 1899 to 1913. At several turning-points, in both depressions and booms, wage-rates lag decisively after employment. Whether this lag is a full year or not is uncertain, as no reliable data on wages were available before the War, except in the annual form. If the pre-War lag was in fact only six to ten months,³⁶ the annual data might well appear as in Chart 11. How much the lag is between employment and the composite product, purchasing power, is still more problematical. In amplitude, employment appears to be much more sensitive to the business cycle than are wage-rates — perhaps more than twice as sensitive.³⁷ This means that the composite product representing pecuniary buying power probably lags less than half as long after employment as do wage-rates. It seems clear, however, that the employment index *probably forecasts by a few months the commercial buying power of those*

EMPLOYMENT CYCLES AND BUYING POWER

large numbers of our people whose earnings are in the form of industrial wages. Indirectly this fact is full of meaning to the social worker as well as to the business man.

VII

FORECASTING EMPLOYMENT CYCLES

THIS naturally suggests the question, whether we can forecast unemployment itself from the fluctuations of other economic indexes. Professor Warren M. Persons has demonstrated the possibility of forecasting general business conditions on the objective basis of statistical and economic analysis.³⁸ Although, in constructing his barometer and his forecaster of business, he gave no attention to data representing employment or unemployment, the forecaster does very effectively forecast unemployment cycles, by an interval of approximately a half-year, as is shown in Chart 12. The writer's analysis of employment, though conducted as an independent research without reference to any other economic indexes, "ties in" so well with several members of Persons's business group ("Group B") that

FORECASTING EMPLOYMENT CYCLES

his general business forecaster proves very satisfactory for our purpose. In short, the problem of forecasting cyclical unemployment-

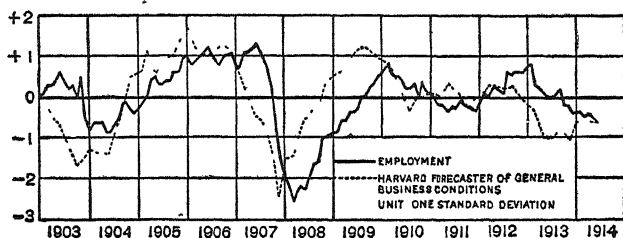


CHART 12

EMPLOYMENT AND A BUSINESS FORECASTER, 1903-1914

ment is shown to be essentially that of forecasting business cycles themselves.

The close linkage which has been shown to exist between cyclical employment and certain of its economic correlatives should lead all who are interested in employment fluctuations — whether for commercial or industrial or sociological purposes — to keep in touch with current employment measurements, and with the business forecasts of reputable statistical agencies. Eventually, per-

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haps, we shall achieve control over some of the more harmful phases of the business cycle.³⁹ But until this is done, the possibility of tracing the current fluctuations of employment, and of forecasting its future fluctuations several months in advance, may go far to alleviate the evils due to the intimate relation between unemployment and business cycles in the United States during the last twenty years.

THE END

APPENDIX

APPENDIX

NOTES TO ALL CHAPTERS

1. The employment figures also yield other useful information, but in this study the question at issue is simply employment cycles. This requires us to leave out of consideration the important seasonal aspect of the unemployment problem. The effects of labor disputes, sickness, old age, disability, vacations, "loafing," and the gradual building-up, decay, or removal of industries are also ignored here.

A discussion of the methods used in constructing index numbers in general, and in testing their reliability, is presented by Professor Irving Fisher in *The Making of Index Numbers*, which is Volume One of the publications of the Pollak Foundation for Economic Research.

Chapter I

2. For the writer's view on the use of the index method for measuring unemployment, see Harvard Economic Service, *Special Letter*

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(October 8, 1921), p. 6; and *Journal of American Statistical Association*, vol. xviii, March, 1922, p. 55.

3. For a good example of this method of attack, see Ernest S. Bradford's note on "Methods of Measuring Unemployment," *Quarterly Publication of the American Statistical Association*, vol. xvii (December, 1921), pp. 983-94.
4. Hornell Hart, *Fluctuations in Unemployment in Cities of the United States, 1902-1917*, vol. 1, no. 2, of the Studies published by the Helen S. Trownstine Foundation, Cincinnati, Ohio.

Chapter II

5. For further treatment of the economic and statistical considerations involved, see *Review of Economic Statistics*, prel. vol. 4 (January, 1922), pp. 25-26.
6. Source: *Abstract of Census of Manufactures* (1914), p. 272, and (for 1919) the preliminary general report on manufactures in the United States. The decennial Censuses of Occupations, for the manufacturing and mechanical pursuits, disclose a similar relationship among the States.

NOTES TO CHAPTER III

Chapter III

7. Throughout the present investigation the methods employed for elimination of seasonal variation, long-time or "secular" trend, etc., are based upon those devised by Professor Warren M. Persons. See *The Review of Economic Statistics*, prel. vol. 1 (January and April, 1919), pp. 3-205. Variations were introduced by the writer only where necessitated by the special nature of some of the employment data.
8. The data have been regularly published in the Bureau's *Annual Reports on the Statistics of Manufactures*.
9. Although the data are comprehensive, they have not remained equally so throughout the period; for instance, in 1899 about 360,000, or 82 per cent, of the 438,000 wage-earners shown by the United States Census for Massachusetts were covered by the reports of the State Bureau; by 1904, the number had risen to 430,000, or 88 per cent. It is impossible to determine precisely the degree of inclusiveness after 1904, because in the subsequent census years the Bureau adopted outright the Federal Bureau's figures for Massachusetts;

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but the percentage appears to have risen decisively, probably to 95 per cent or more.

10. Another important objection, statistical in its nature, lies in the discontinuity of the Massachusetts data during the past sixteen years. Prior to 1906, the data published yearly covered identical establishments over a period of twenty-four months, so that the actual degree of change between each December and the following January in these establishments can be readily ascertained. This policy of "overlapping" the yearly reports was not maintained after 1906, and consequently the problem of building up a reliable, continuous series for an extended period is not an easy one. After 1906, the data do not form a true statistical series at all, but a series of floating fragments connected with each other in a very loose and uncertain manner.
11. For a discussion of the method by which the fragments were welded into a continuous series, see *Journal of American Statistical Association*, vol. xviii (June, 1922), pp. 233-34.
12. The data prior to 1916 were obtained from the Bureau's *Annual Reports*. Those for 1917 and

NOTES TO CHAPTER III

1918 were made available through the courtesy of Mr. J. A. T. Gribbin of the Bureau.

13. For a detailed discussion of the methods employed, see *Review of Economic Statistics*, prel. vol. 4 (January, 1922), pp. 26-34.
14. The "probable error" of a correlation coefficient means so little, when applied to time-series of economic data, that in all cases it is omitted in this monograph.
15. The Massachusetts unemployment index, being quarterly, could not well be utilized in a monthly composite.
16. Compare the table on page 12.
17. For the 1919 Census data, see below, especially Chart 5.
18. Compare *United States Abstract of Manufactures* (1914), p. 435.
19. For the method utilized, see *Journal of the American Statistical Association*, vol. xviii (June, 1922), pp. 230-32.
20. The year 1904 was peculiar, and the agreement in that year was much less close for the reasons indicated earlier in this monograph. The fairly decisive lag at the turning-points of the Census fragment seems to represent a

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more sluggish response to the industrial reversal by the country as a whole than by the three States represented in the continuous index.

Chapter IV

21. Based on the average for 1919 as 100 per cent, but not corrected for seasonal variation.
22. *Review of Economic Statistics*, prel. vol. 4 (January, 1922), pp. 23, 24, 32, 33.
23. These figures have been kindly supplied by Ethelbert Stewart, United States Commissioner of Labor Statistics. The relation of link-relatives to chain-relatives may be seen in the following example: Suppose that between January and February, 1919, the number employed in a certain industry diminished by 4.0 per cent (link-relative $1.00 - .04 = 0.96$), between February and March diminished by 5.0 per cent (link 0.95), between March and April diminished 3 per cent (link 0.97), between April and May increased 4 per cent (link 1.04). Then the chain-relative for February, 1919, would be 0.96, for March $0.96 \times 0.95 = 0.912$, for April $0.96 \times 0.95 \times 0.97 = 0.884$, and for May $0.96 \times 0.95 \times 0.97 \times 1.04 = 0.92$.

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24. This objection has been overcome, in large measure, by a considerable expansion of the number and variety of industries, beginning with the summer of 1922. The Bureau of Labor reports now cover about 1,500,000 employees, in more than forty industries.
25. The Wisconsin curve in chart 4 really represents not one series but two, which, though not wholly alike in nature, have been grafted together by the Industrial Commission of Wisconsin. The figures reported monthly since July, 1920, are based on establishments representing one fourth to one third of the wage-earners engaged in manufacturing industries in Wisconsin. The quarterly figures, extending from the first quarter of 1915 to the second quarter of 1920, covered a much smaller proportion, probably fifteen to twenty per cent. Differences in the inclusiveness, the industrial composition, and the purpose of the two series of reports may account for the peculiarity in the form of the curve. The purpose of the earlier reports was simply to obtain data on the incidence of industrial accidents, in order to check up the rates provisionally assumed in the Workmen's Compensation Act. Until July, 1920, reports

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were made to the Commission only by self-insured employers, but after July, 1920, many employers insuring with the liability companies began to report. It is especially probable that a standardization of the industrial weights in the two periods will make the composite series more trustworthy as a continuous record for the years since 1915.

The writer's surmise on this point is confirmed by the independent study of the problem by A. J. Altmeyer, of the Commission's staff; his intention is now to standardize the weights. For further facts on the nature of this series, see Industrial Commission of Wisconsin, *Biennial Report*, 1918-20, esp. p. 81; also the Commission's monthly *Bulletins*.

26. The period used in determining the standard deviation for each of these series was 1914-20.
27. Source: Colonel Leonard P. Ayres, Chief of Statistics Branch, General Staff, *The War with Germany: A Statistical Summary*, p. 15.
28. Secretary of War, *Annual Report* (1919), p. 17.
29. This statement refers, of course, to the gen-

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eral index. Employment had begun to improve earlier in the summer in some industries, notably textiles. See *Review of Economic Statistics*, prel. vol. 4 (January, 1922), p. 20, chart 3.

30. It may be observed that approximately the last million men were returned to civil life in more moderate installments, much better timed with reference to business conditions.

Chapter V

31. See Edmund E. Day, "Measurement of variations in the National Real Income," *Quarterly Publication of American Statistical Association*, vol. xvii (March, 1921), p. 559.

Professor Day has carried the idea further, and developed one monthly index for the production of consumers' goods, and another for producers' goods, both commencing with January, 1919. See, *e.g.*, Harvard Economic Service, *Weekly Letter* no. 52 (December 23, 1922), pp. 317, 319.

32. Here the Massachusetts component was obtained by taking the average of the employment and the reversed unemployment figures. To center the average of the quarterly un-

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employment cycles in the middle of the calendar year, a five-quarter rather than a four-quarter average was used — December 31 of the previous year, and March 31, June 30, September 30 and December 31 of the current year.

The New York unemployment data are based upon the reports of all the unions in the State, rather than the representative selection, one fourth to one third as great, embodied in the monthly data.

33. Edmund E. Day, *An Index of the Physical Volume of Production*, pp. 62, 63.
34. Described in the *Review of Economic Statistics*, prel. vol. 4 (January, 1922), pp. 35–39.

Chapter VI

35. This series represents wage-rates per hour, according to the investigations of Dr. Rubinow, and of Professor Douglas and Miss Lamberson, based on United States Bureau of Labor data. Compare Paul H. Douglas and Frances Lamberson, "The Movement of Real Wages, 1890–1918," *American Economic Review*, vol. xi, no. 3 (September, 1921).

NOTES TO CHAPTER VI

36. This is approximately the lag of recently constructed quarterly and monthly wage indexes after the employment index, for the period 1914-22. See W. Randolph Burgess, "Index Numbers for the Wages of Common Labor," *Journal of American Statistical Association*, vol. xviii, p. 103.
37. As measured by the standard deviation of the employment and wage indexes, which were approximately 3.5 and 1.5 per cent, respectively, between 1899 and 1913. Since the employment index does not take into account either over-time or part-time, 3.5 per cent is really a *lower limit* of the elasticity of employment fluctuations.
38. *Review of Economic Statistics*, prel. vol. (January and April, 1919), pp. 3-205.
39. The possibilities of curbing fluctuations in business activity are considered in other publications of the Pollak Foundation for Economic Research.

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